

CLAIMS

What is claimed is:

1. A fluid sterilization apparatus comprising:
 - a sterilization chamber having a cavity therein; and
 - 5 a nozzle for receiving pressurized fluid and directing a spray of the fluid into the cavity; and
 - an electron beam generator having an exit window, the electron beam generator being mounted to the sterilization chamber for directing a beam of electrons through the exit window into the cavity to the sterilization chamber to
 - 10 irradiate the spray of fluid, the nozzle being configured to direct the spray of fluid substantially parallel and proximate to the exit window.
2. The apparatus of Claim 1 further comprising a pump for pumping the fluid.
3. The apparatus of Claim 2 further comprising a filter for filtering particles from the fluid.
- 15 4. The apparatus of Claim 1 in which the nozzle directs a thin, flat film of fluid within the sterilization chamber.
5. The apparatus of Claim 4 in which the film of fluid is about .004 to .005 inches thick.
- 20 6. The apparatus of Claim 4 in which the cavity of the sterilization chamber includes an outlet through which fluid that is sterilized is removed.

7. The apparatus of Claim 6 in which the cavity of the sterilization chamber includes a recycling passage for directing a portion of the spray of fluid back for further irradiation.
8. The apparatus of Claim 7 in which the cavity includes a wall between the cavity outlet and the recycling passage for directing any fluid from the spray of fluid unable to pass over the wall into the recycling passage.
9. A fluid sterilization apparatus comprising:
a sterilization chamber having a cavity therein;
a nozzle for receiving pressurized fluid and for directing a spray of the fluid into the cavity, the spray of the fluid being a thin, flat, film of fluid; and
an electron beam generator mounted to the sterilization chamber for directing a beam of electrons into the cavity of the sterilization chamber to irradiate the spray of fluid.
10. The apparatus of Claim 9 in which the film of fluid is about .004 to .005 inches thick.
11. A fluid sterilization apparatus comprising:
a container for containing a supply of fluid;
a wheel system having circumferential surfaces, the wheel system being rotatably mounted within the container, a portion of the wheel system for extending above the supply of fluid with rotation of the wheel system drawing a film of fluid upwardly out of the supply of fluid on the circumferential surfaces;
a doctoring member for controlling the thickness of the film of fluid on the circumferential surfaces of the wheel system;
an electron beam generator for irradiating the film of fluid with a beam of electrons to sterilize the fluid; and

a fluid removal member for removing sterilized fluid from the wheel system.

12. The apparatus of Claim 11 in which the wheel system comprises a first wheel rotatably mounted within the container for drawing the film of fluid from the supply of fluid.
13. The apparatus of Claim 12 in which the wheel system further comprises a second wheel rotatably contacting the first wheel for receiving fluid from the first wheel to be irradiated by the electron beam generator.
14. A method of forming a fluid sterilization apparatus comprising:
providing a sterilization chamber having a cavity therein;
forming a nozzle for receiving pressurized fluid and directing a spray of the fluid into the cavity; and
mounting an electron beam generator to the sterilization chamber, the electron beam generator having an exit window and for directing a beam of electrons through the exit window into the cavity of the sterilization chamber to irradiate the spray of fluid, the nozzle being configured to direct the spray of fluid substantially parallel and proximate to the exit window.
15. The method of Claim 14 further comprising providing a pump for pumping the fluid.
16. The method of Claim 15 further comprising providing a filter for filtering particles from the fluid.
17. The method of Claim 14 further comprising forming the nozzle to be capable of producing a thin, flat film of fluid.

18. The method of Claim 17 further comprising forming the nozzle to be capable of producing the film of fluid .004 to .005 inches thick.
19. The method of Claim 17 further comprising forming the cavity of the sterilization chamber with an outlet through which fluid that is sterilized is removed.
20. The method of Claim 19 further comprising forming a recycling passage in the cavity of the sterilization chamber for directing a portion of the spray of fluid back for further irradiation.
21. The method of Claim 20 further comprising forming a wall within the cavity between the cavity outlet and the recycling passage for directing any fluid from the spray of fluid unable to pass over the wall into the recycling passage.
22. A method of sterilizing fluid comprising:
directing a spray of pressurized fluid from a nozzle assembly into a cavity of a sterilization chamber; and
irradiating the spray of fluid with a beam of electrons from an electron beam generator mounted to the sterilization chamber, the electron beam generator having an exit window through which the beam of electrons is directed, the nozzle being configured to direct the spray of fluid substantially parallel and proximate to the exit window.
23. The method of Claim 22 further comprising pumping the fluid to the nozzle assembly with a pump.
24. The method of Claim 23 further comprising filtering particles from the fluid with a filter.

25. The method of Claim 22 further comprising forming the spray of fluid as a thin, flat film of fluid.
26. The method of Claim 25 further comprising forming the film of fluid about .004 to .005 inches thick.
- 5 27. The method of Claim 25 further comprising removing fluid that is sterilized from the cavity of the sterilization chamber through an outlet.
28. The method of Claim 27 further comprising recycling a portion of the spray of fluid back for further irradiation through a recycling passage.
29. The method of Claim 28 further comprising recycling an initial spray of fluid.
- 10 30. The method of Claim 31 further comprising directing any fluid into the recycling passage that is unable to pass over a wall within the cavity between the cavity outlet and the recycling passage.
31. A method of forming a fluid sterilization apparatus comprising:
 - providing a container capable of containing a supply of fluid;
 - 15 rotatably mounting a wheel system having circumferential surfaces within the container, a portion of the wheel system for extending above the supply of fluid with rotation of the wheel system drawing a film of fluid upwardly out of the supply of fluid on the circumferential surfaces;
 - providing a doctoring member for controlling the thickness of the film of
 - 20 fluid on the circumferential surfaces of the wheel system;
 - providing an electron beam generator for irradiating the film of fluid with a beam of electrons to sterilize the fluid; and

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providing a fluid removal member for removing sterilized fluid from the wheel system.

32. The method of Claim 31 further comprising providing the wheel system with a first wheel rotatably mounted within the container for drawing the film of fluid from the supply of fluid.
33. The method of Claim 32 further comprising providing the wheel system with a second wheel rotatably contacting the first wheel for receiving fluid from the first wheel to be irradiated by the electron beam generator.
34. A method of sterilizing fluid comprising:
 - drawing a film of fluid upwardly out of a supply of fluid contained within a container on circumferential surfaces of a rotating wheel system rotatably mounted within the container, a portion of the wheel system extending above the supply of fluid;
 - controlling the thickness of the film of fluid on the circumferential surfaces of the wheel system with a doctoring member;
 - irradiating the film of fluid with a beam of electrons from an electron beam generator to sterilize the fluid; and
 - removing the sterilized fluid from the wheel system with a fluid removal member.
35. The method of Claim 34 further comprising drawing the film of fluid from the supply of fluid with a first wheel of the wheel system.
36. The method of Claim 35 further comprising rotatably contacting a second wheel of the wheel system with the first wheel for receiving fluid from the first wheel for irradiation by the electron beam generator.